

3D MeshMetric

Version 1.0

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SCHOOL OF MEDICINE

3DMeshMetric

3DMeshMetric is a software to **measure** and **display surface-to-surface distance** between two triangle meshes, based on the source code of MeshValmet : <http://www.nitrc.org/projects/meshvalmet>

3DMeshMetric is also a **visualization tool** which permit to **load, modify** and **save VTK files**.

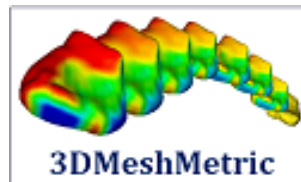
3DMeshMetric

- Visualization tools:
 - Visualize multiple files
 - User editable opacity, color, orientation or type and display of each files
- Smoothing and down-sampling filters.
- Surface-to-surface distance:
 - Signed or absolute distance, advanced parameters
 - User editable color map range
 - Save file with error computed

Software

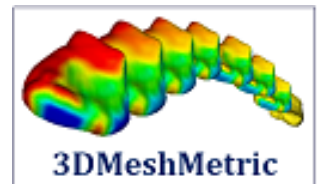
3DMeshMetric is available here :

<http://www.nitrc.org/projects/meshmetric3d>

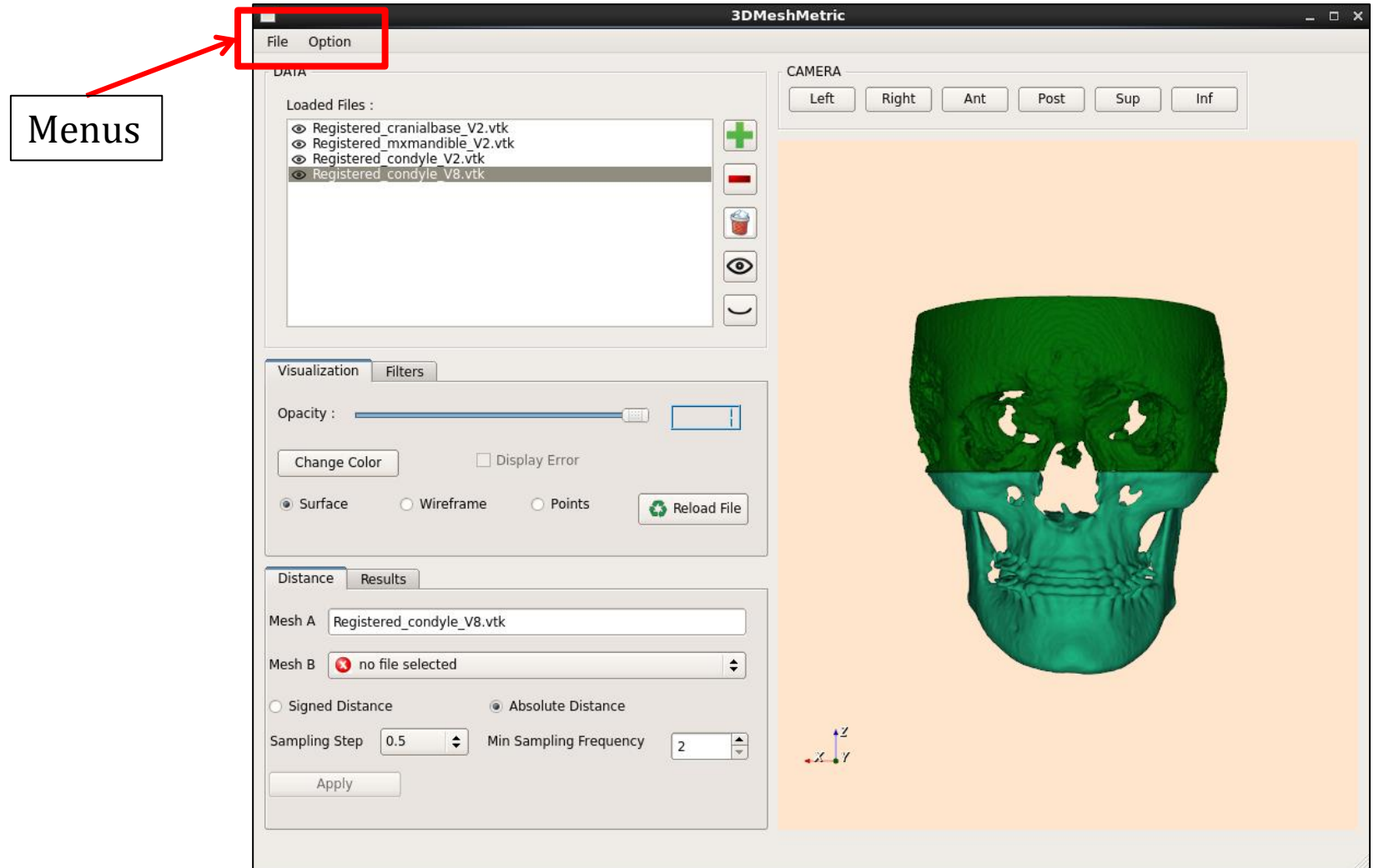


3DMeshMetric

Presentation of the User Interface

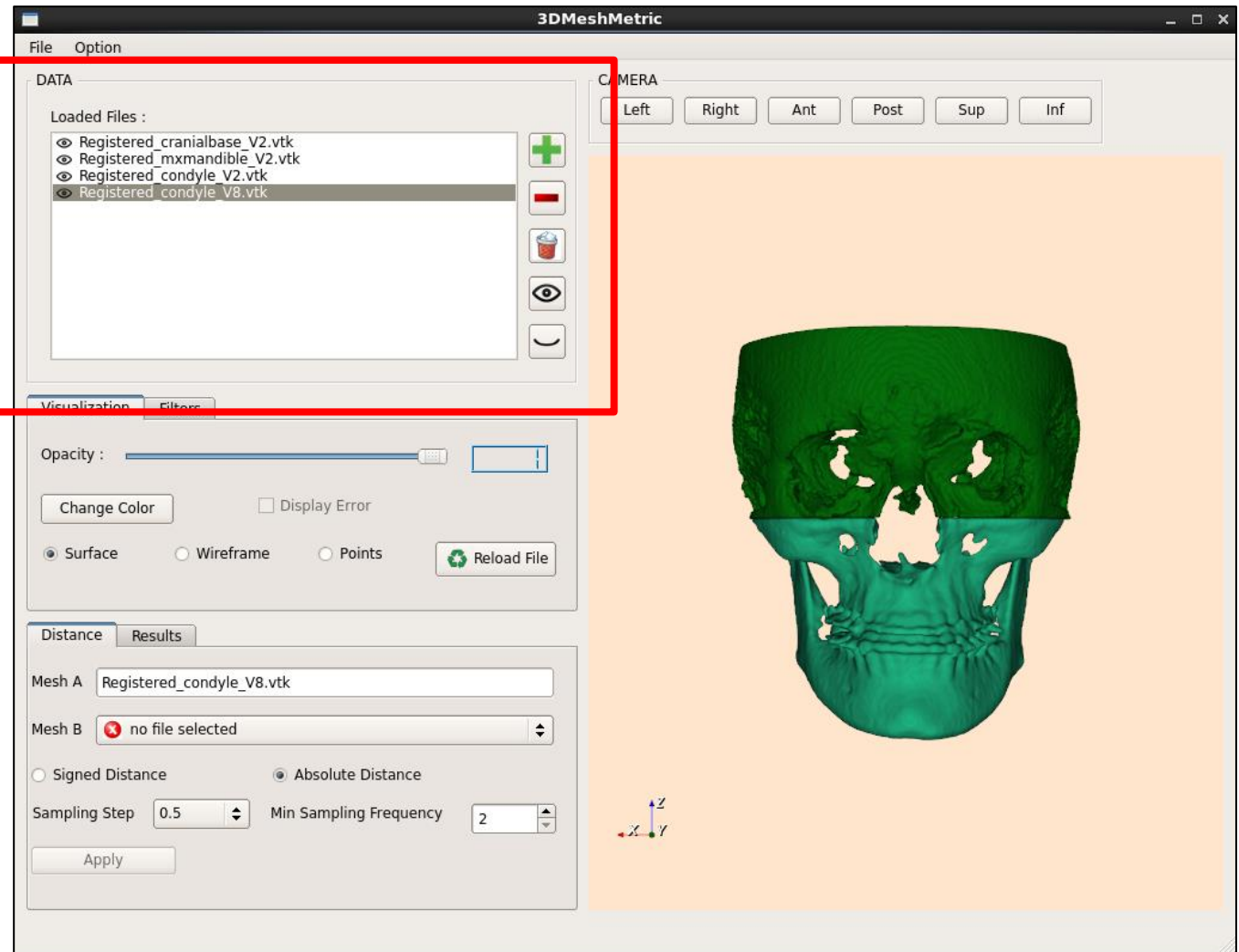


The interface

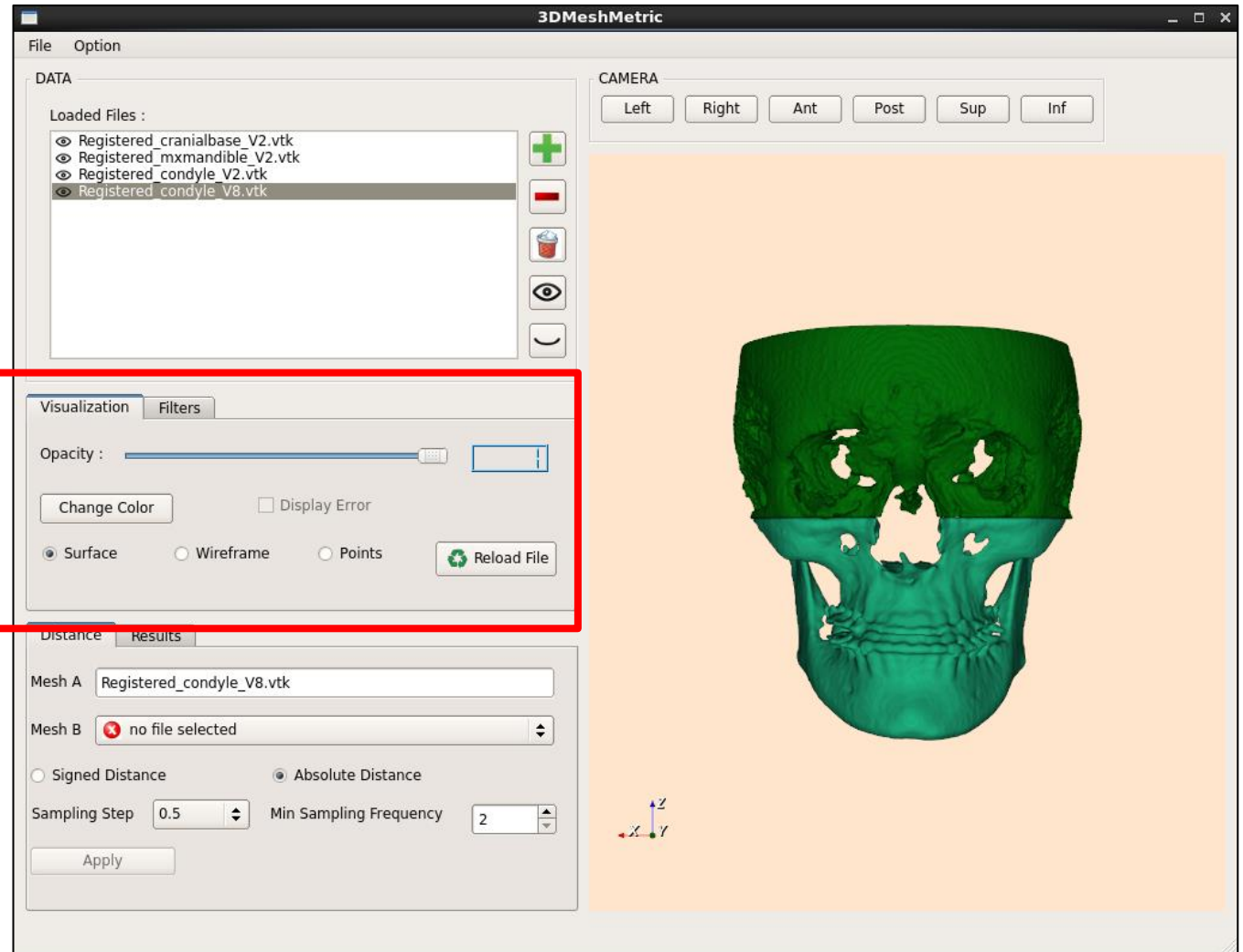


The interface

Data Box

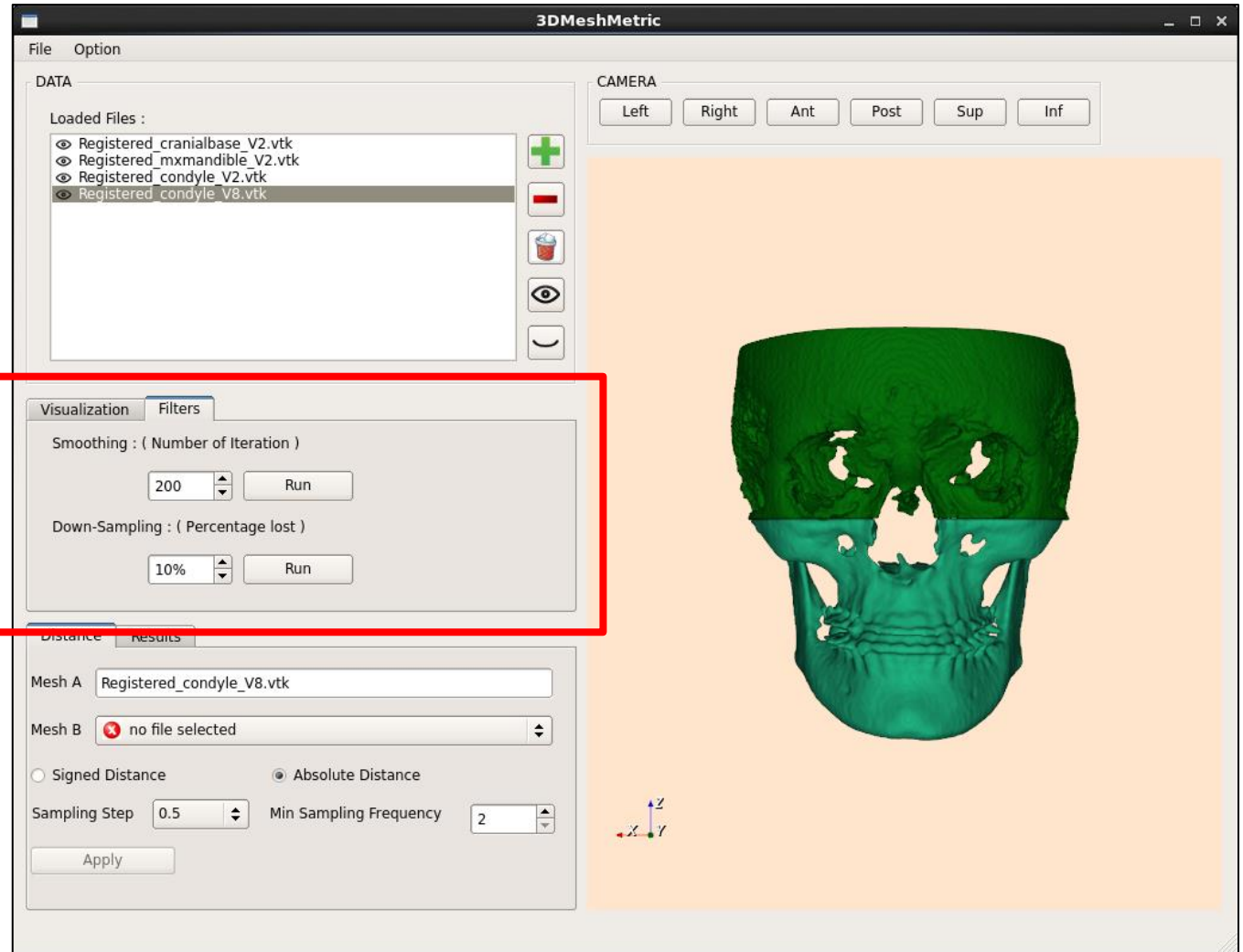


The interface

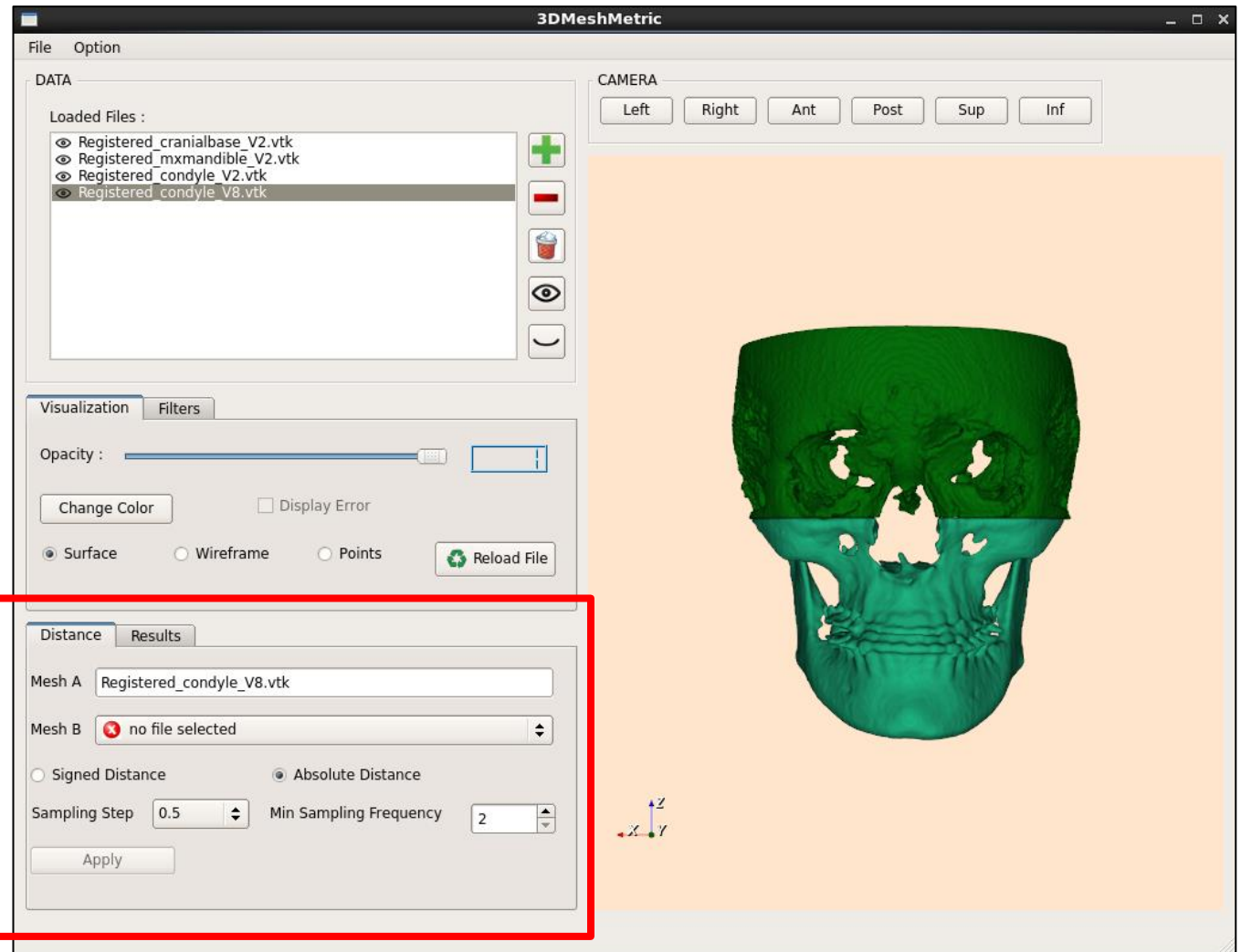


Visualization Box

The interface

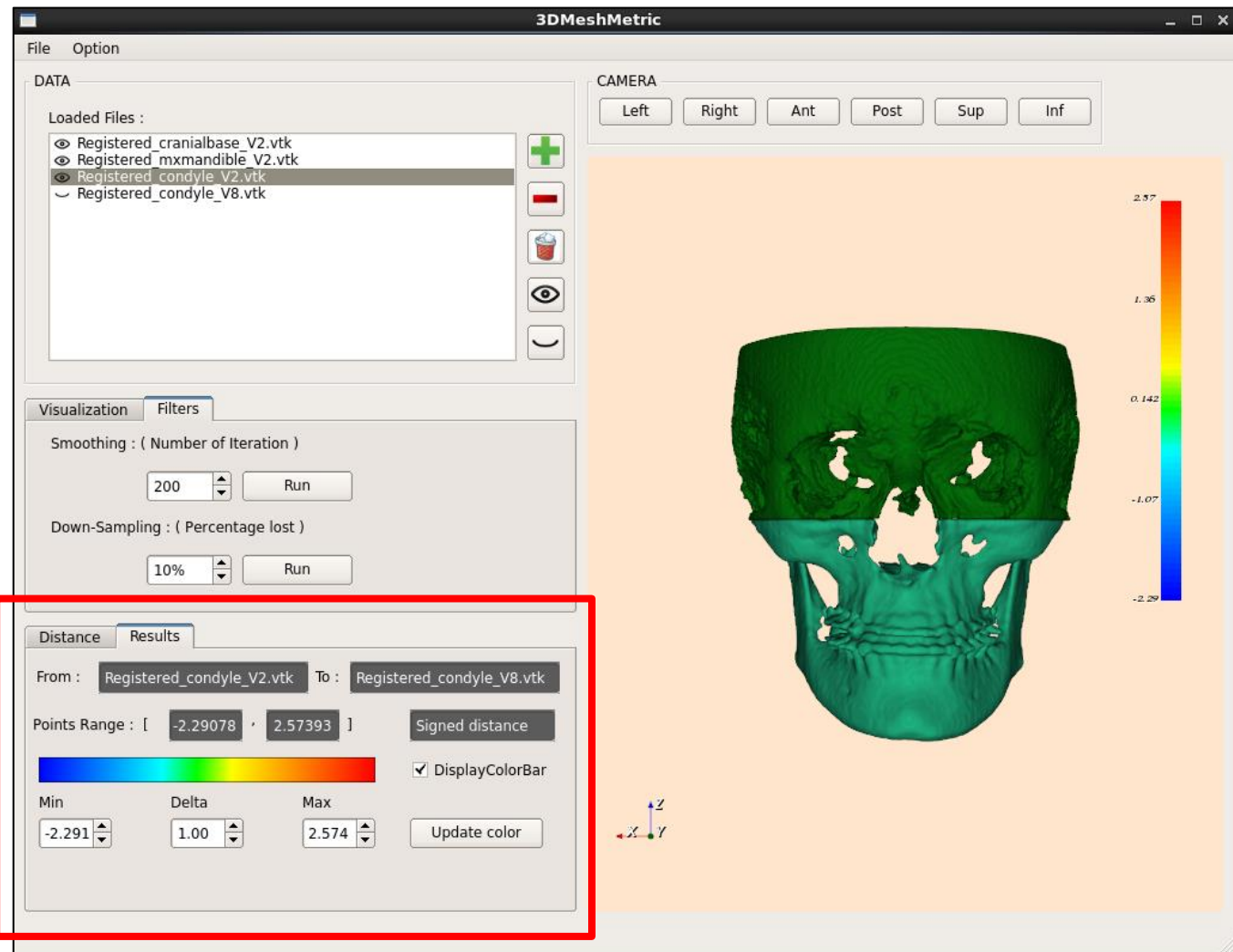


The interface



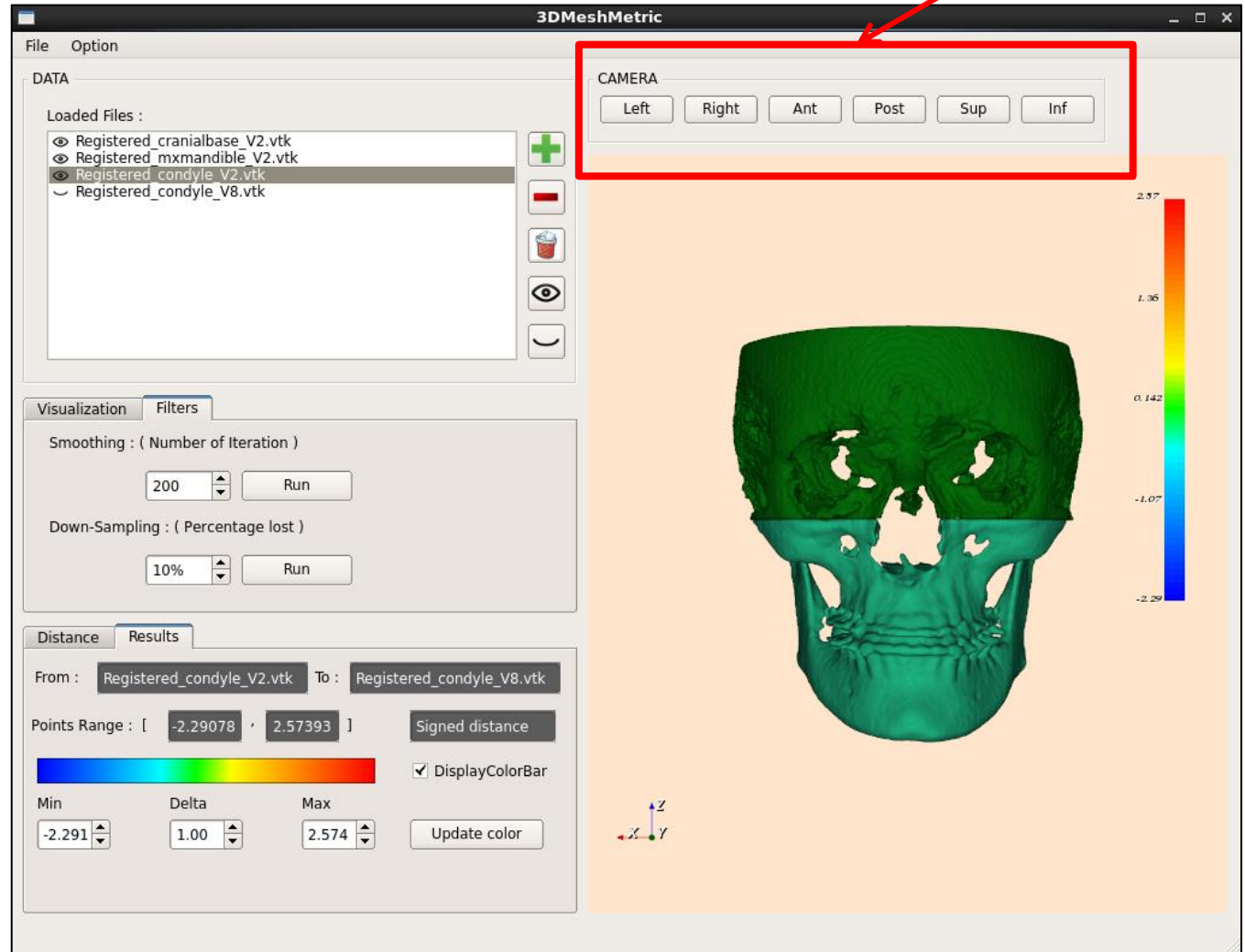
Distance Box

The interface



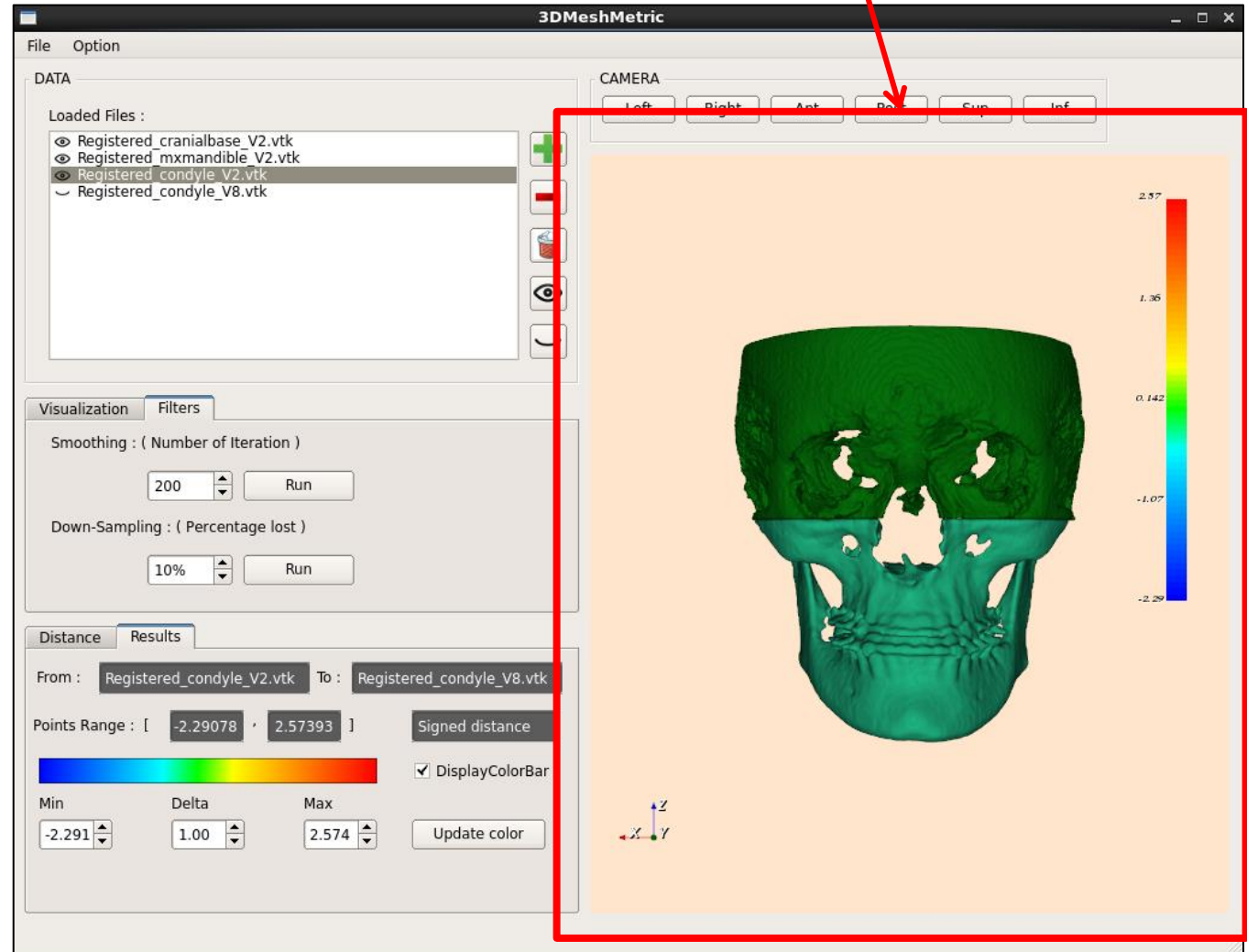
The interface

Camera Box



The interface

Visualization window

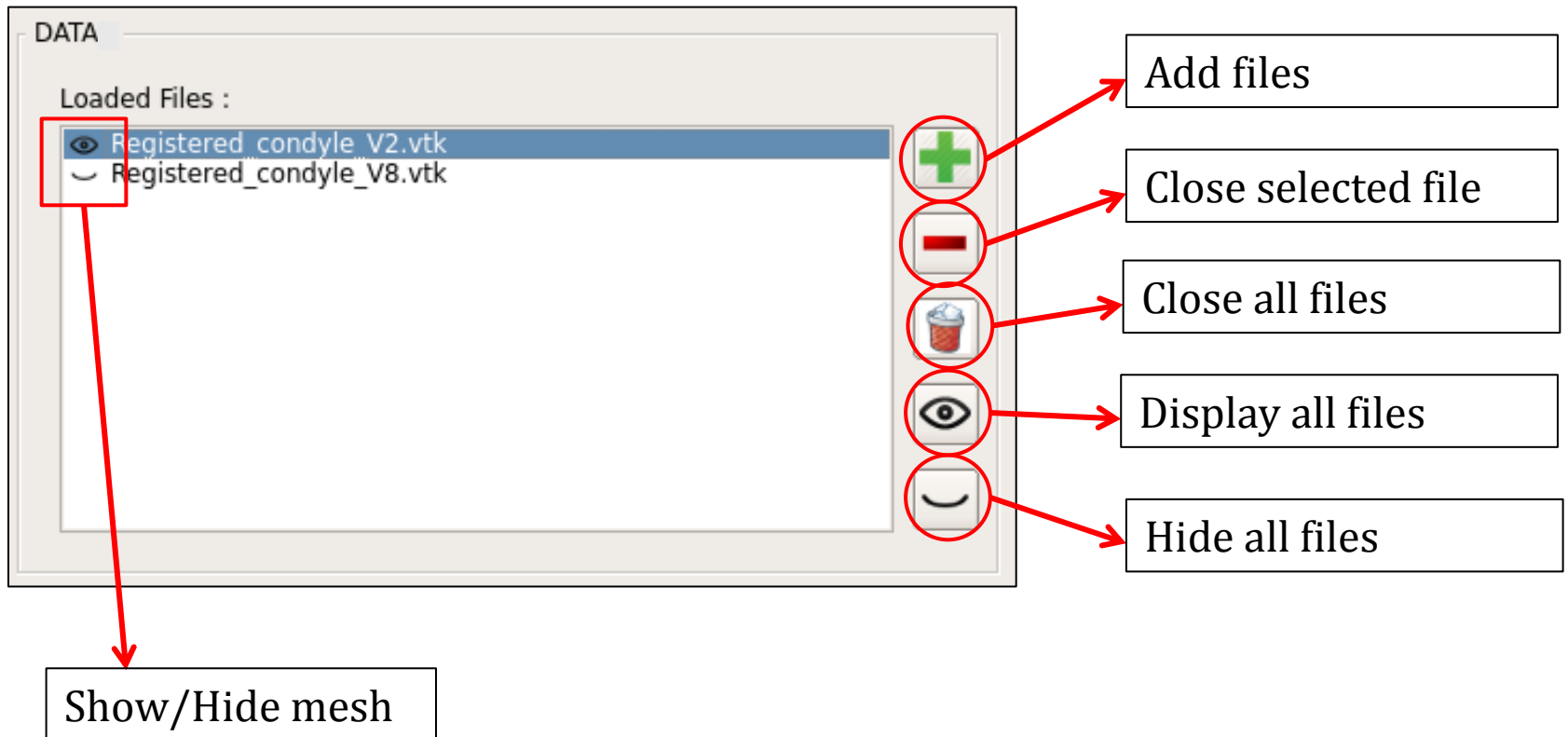


Menus

Two menus :

- File
 - Add new file (Ctrl+A)
 - Add new folder (Ctrl+R)
 - Save file (Ctrl+S)
 - Quit (Ctrl+Q)
- Option
 - Background color

Data Box



Visualization Box

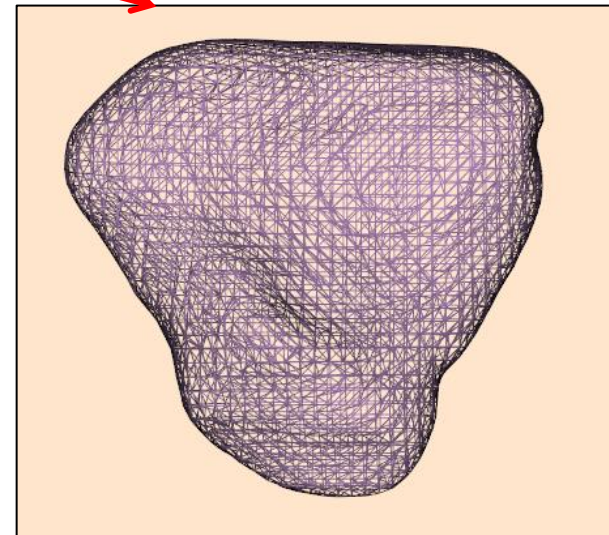
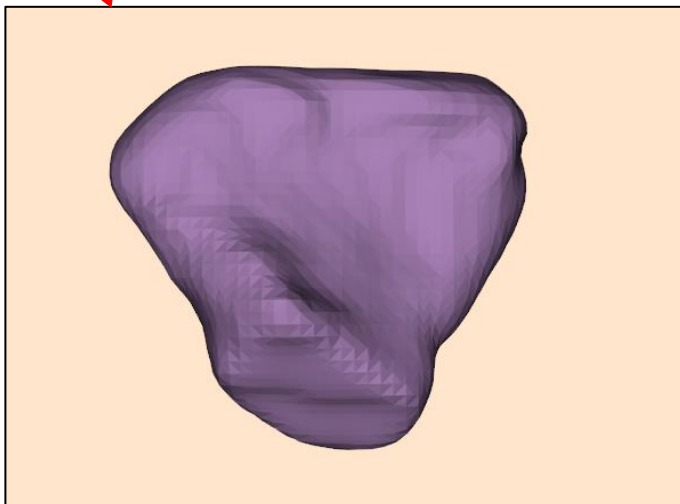
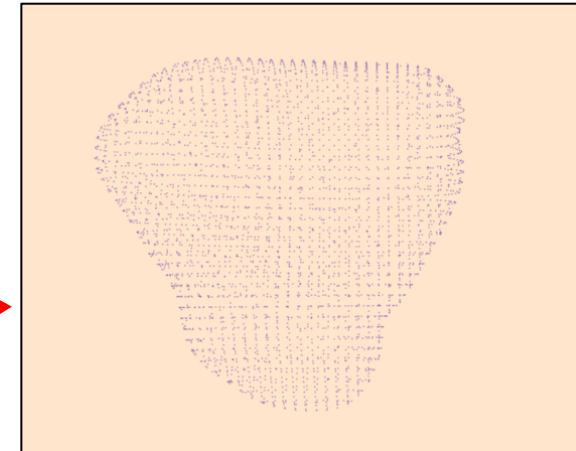
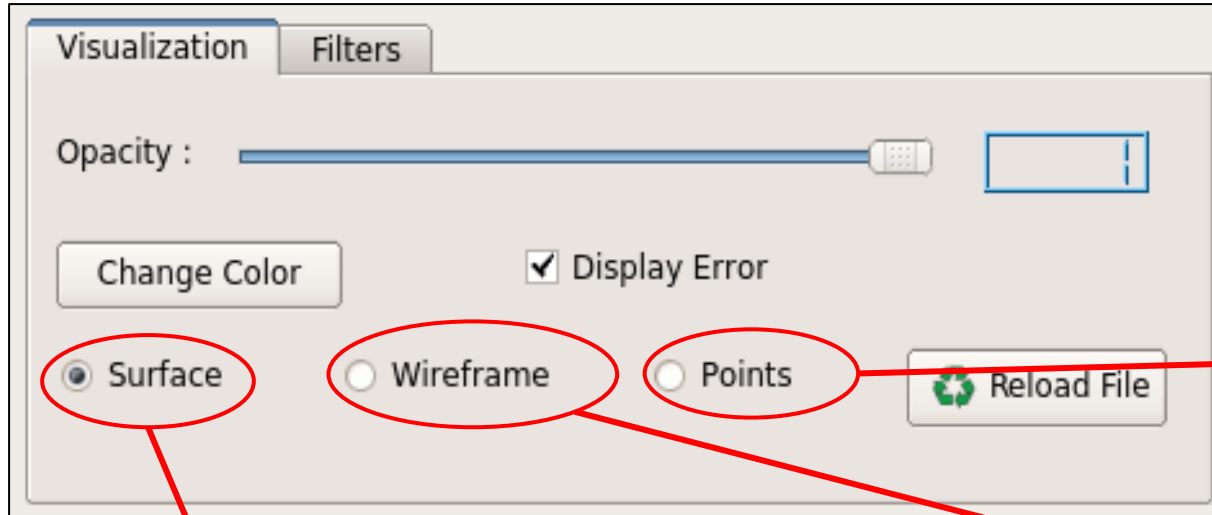
The image shows a software interface titled "Visualization Box" with two tabs: "Visualization" (selected) and "Filters". The interface includes the following elements:

- Opacity:** A horizontal slider with a blue bar and a white knob, followed by a small rectangular input field.
- Change Color:** A button with a red arrow pointing to it from the callout "Change selected mesh color".
- Display Error:** A checked checkbox with a red arrow pointing to it from the callout "Show/Hide the distance color map of the selected mesh".
- Surface/Wireframe/Points:** Three radio buttons. "Surface" is selected, with a red arrow pointing to it from the callout "Change selected mesh color".
- Reload File:** A button with a green refresh icon and a red arrow pointing to it from the callout "Reload the original file".

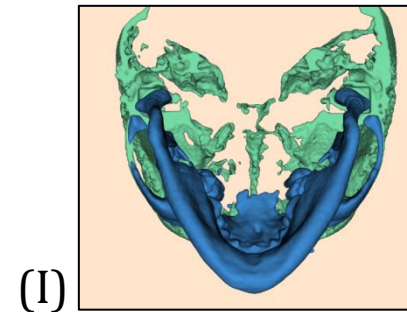
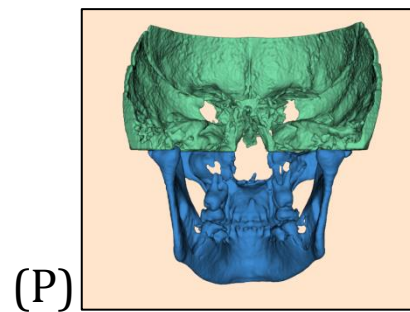
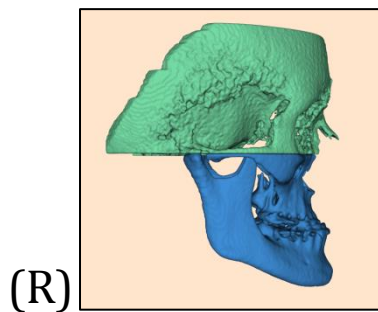
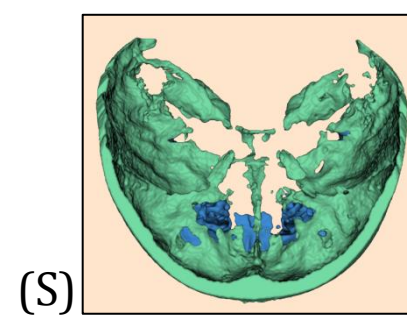
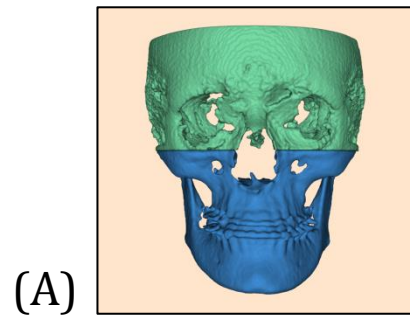
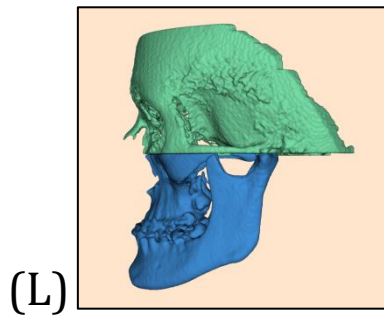
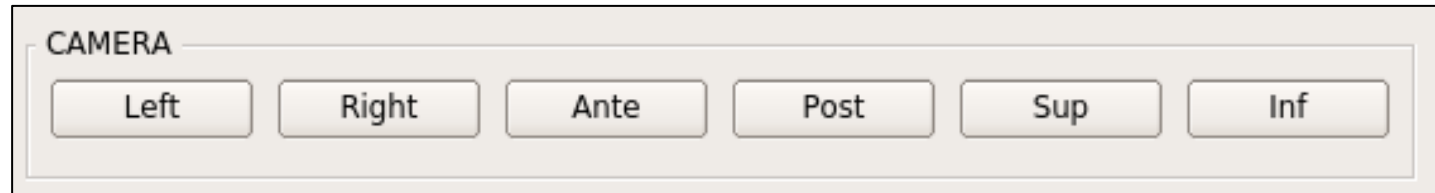
Four callout boxes with red arrows provide the following descriptions:

- Change selected mesh color (points to "Change Color" and "Surface")
- Change selected mesh opacity (points to the "Opacity" slider and input field)
- Show/Hide the distance color map of the selected mesh (points to "Display Error")
- Reload the original file (points to "Reload File")

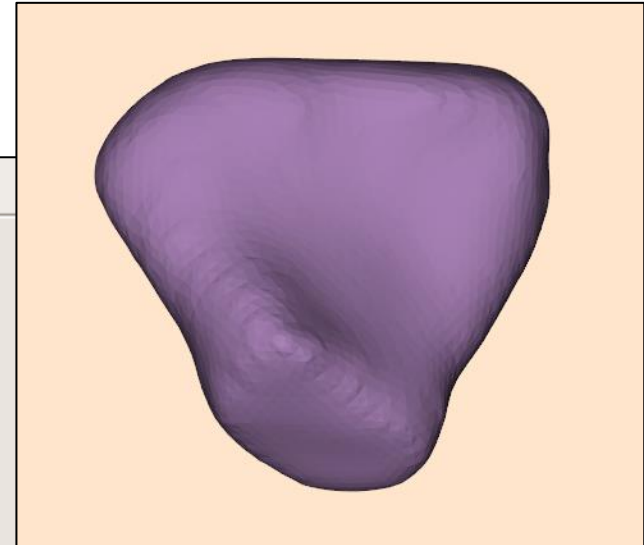
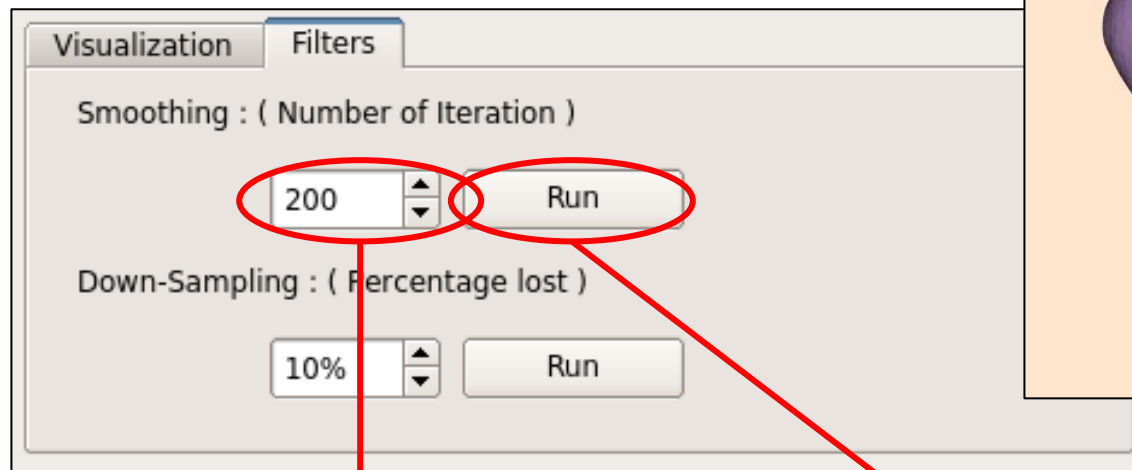
Visualization Box



Camera Box



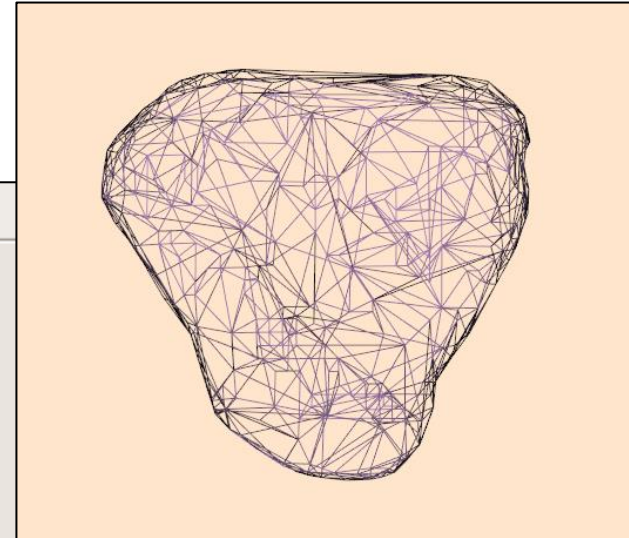
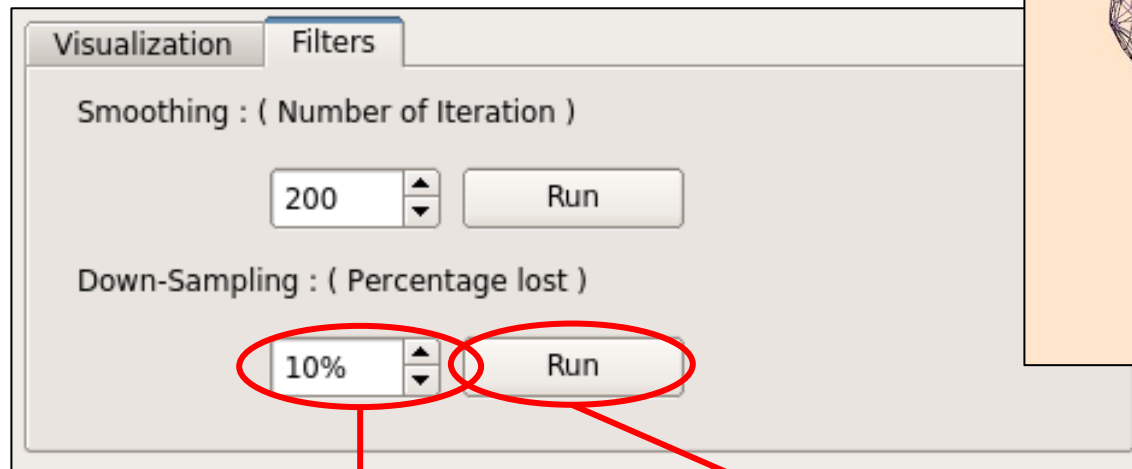
Filters Box



Number of iteration of the smoothing

Apply the smoothing

Filters Box



Percentage of down-sampling

Apply the down-sampling

Distance Box

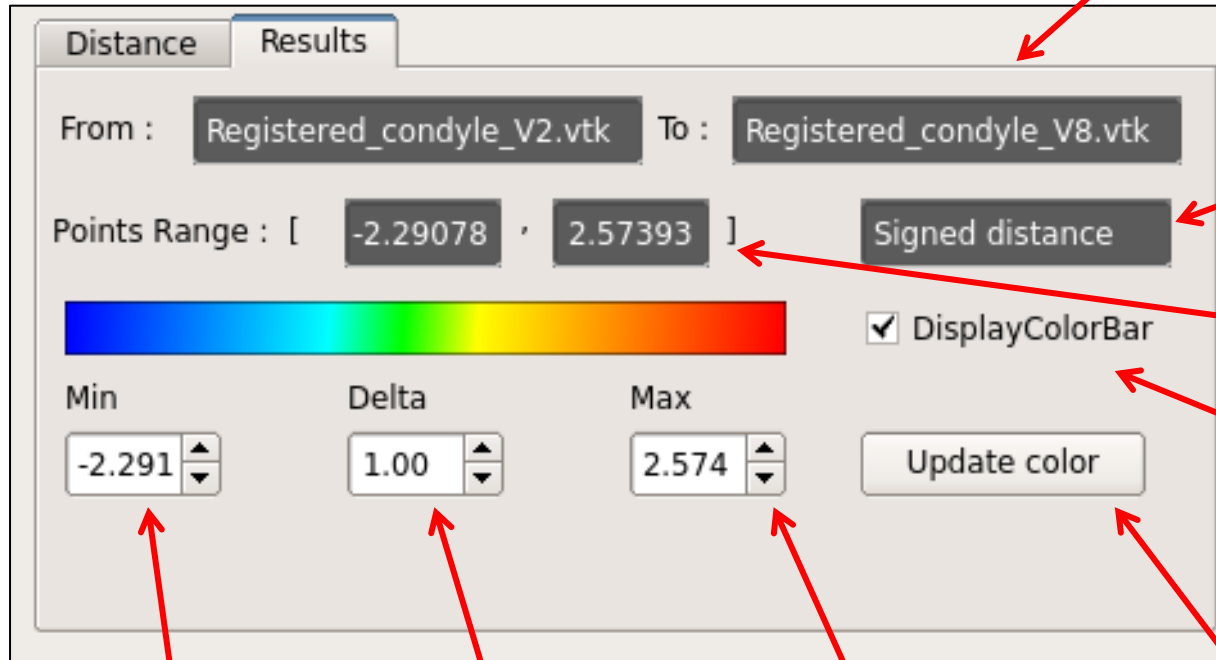
The image shows a software dialog box titled "Distance" with a "Results" tab. The dialog contains the following elements:

- Mesh A:** A text field containing "Registered_condyle_V2.vtk".
- Mesh B:** A dropdown menu with a green checkmark and "Registered_condyle_V8.vtk".
- Distance Type:** Two radio buttons: "Signed Distance" (selected) and "Absolute Distance".
- Sampling Step:** A spinner box set to "0.5".
- Min Sampling Frequency:** A spinner box set to "2".
- Apply:** A button at the bottom left.

Red arrows point from external text boxes to these elements:

- "Mesh A = Selected file" points to the Mesh A text field.
- "Mesh B = one file on the list" points to the Mesh B dropdown.
- "Type of distance computed" points to the radio buttons.
- "Advanced parameters" points to the Sampling Step and Min Sampling Frequency spinners.
- "Compute the distance" points to the Apply button.

Results Box



Names of mesh A and B for the ColorMap displayed

Type of distance

Range of point

Range of point

Show/Hide color bar

Value of blue color

Value of red color

Range of green color, centered on 0

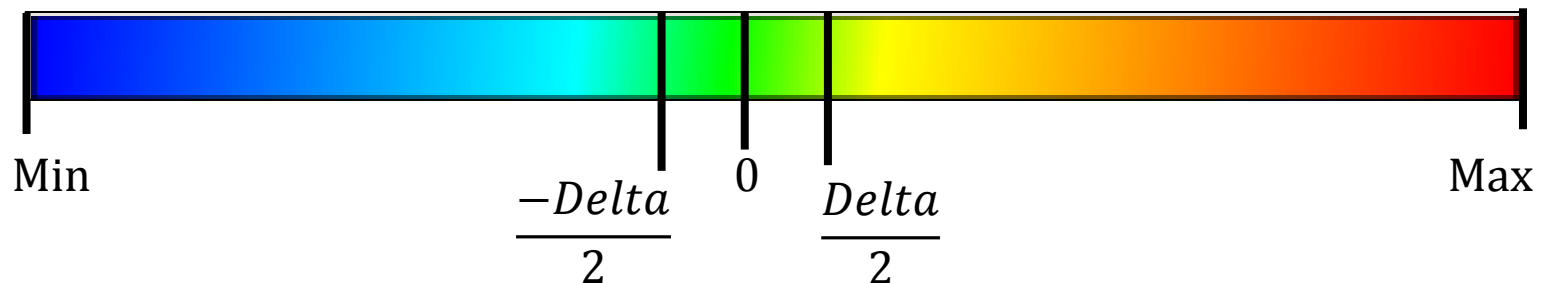
Update the color map with the new values

Results Box

The colorbar can be modified:

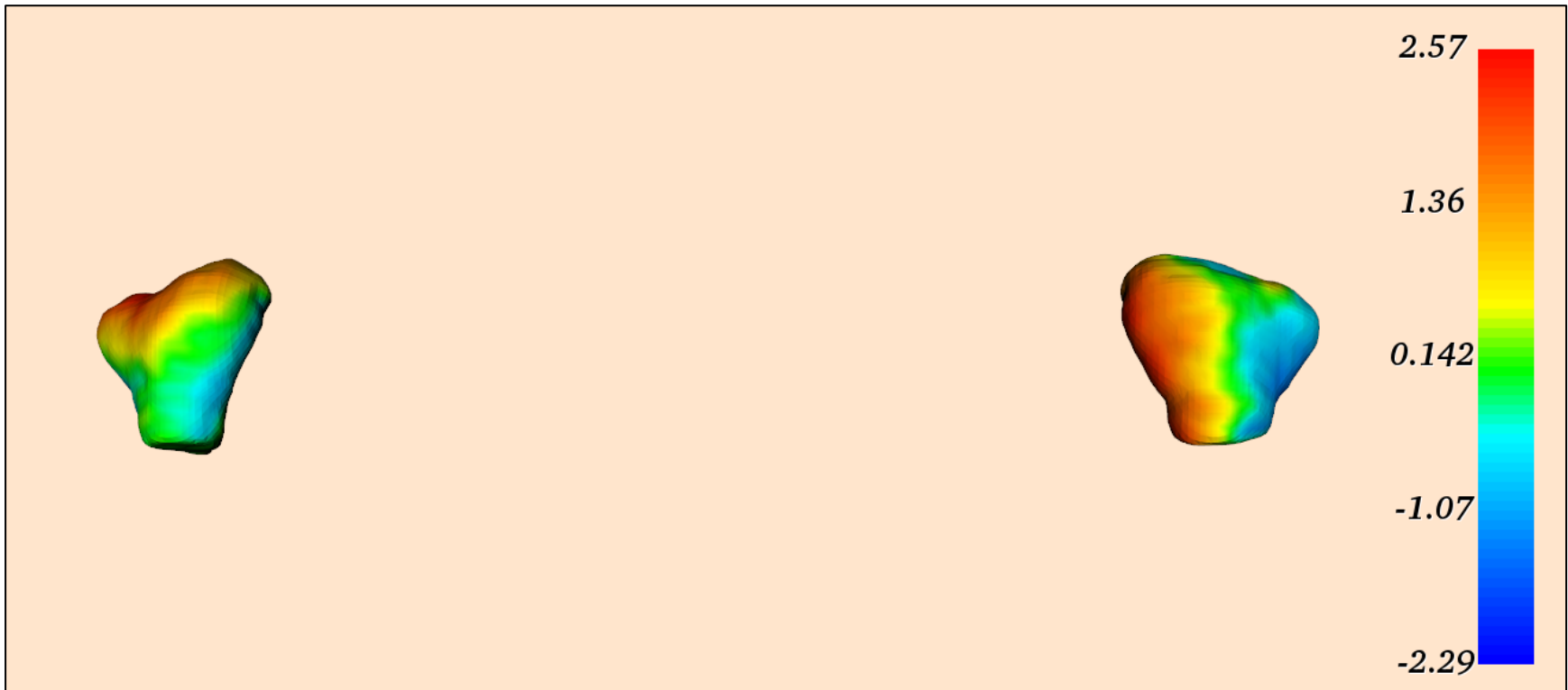
- Choose a minimum value for the blue color
- Choose a maximum value for the red color
- Choose the range of the green color

The points with a distance value of $\pm \frac{\Delta}{2}$ will all have the same color: green.



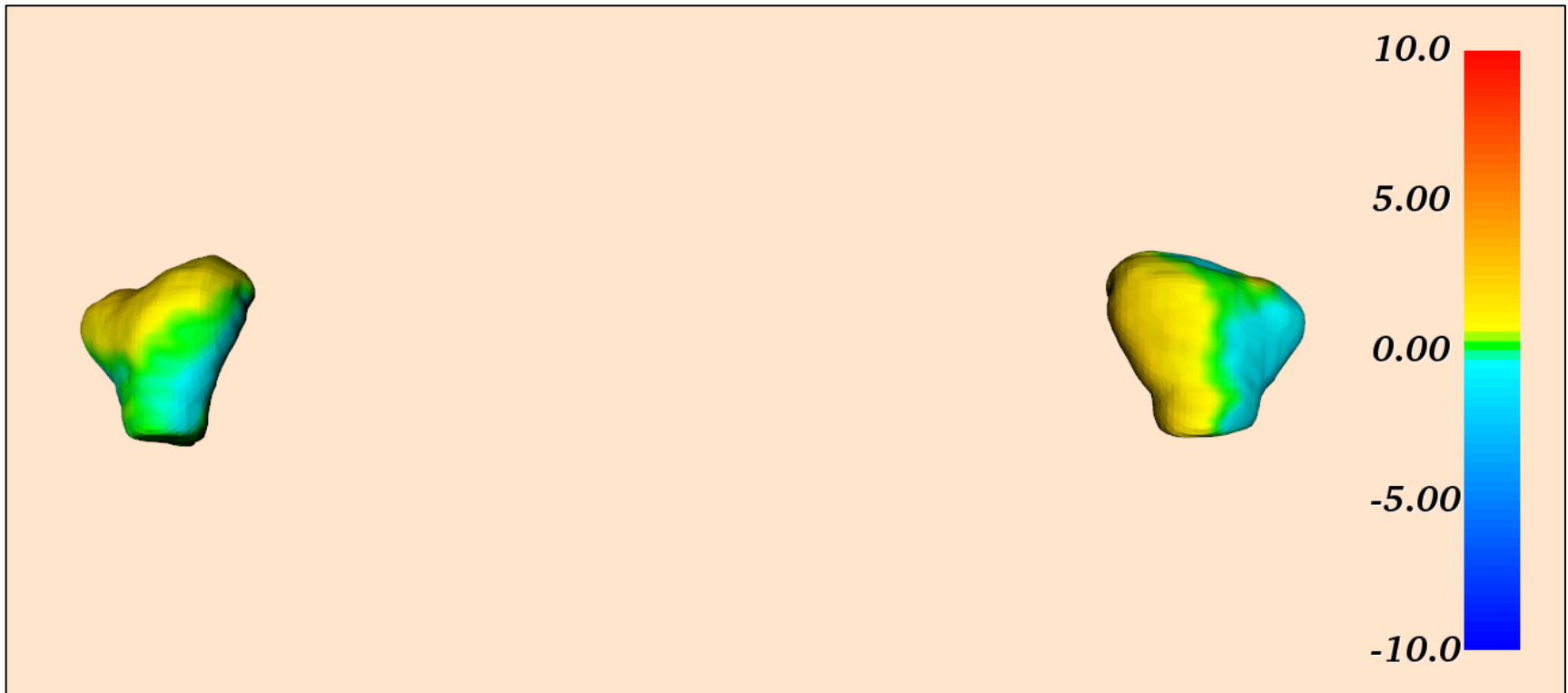
Examples of Color Map

- Signed distance



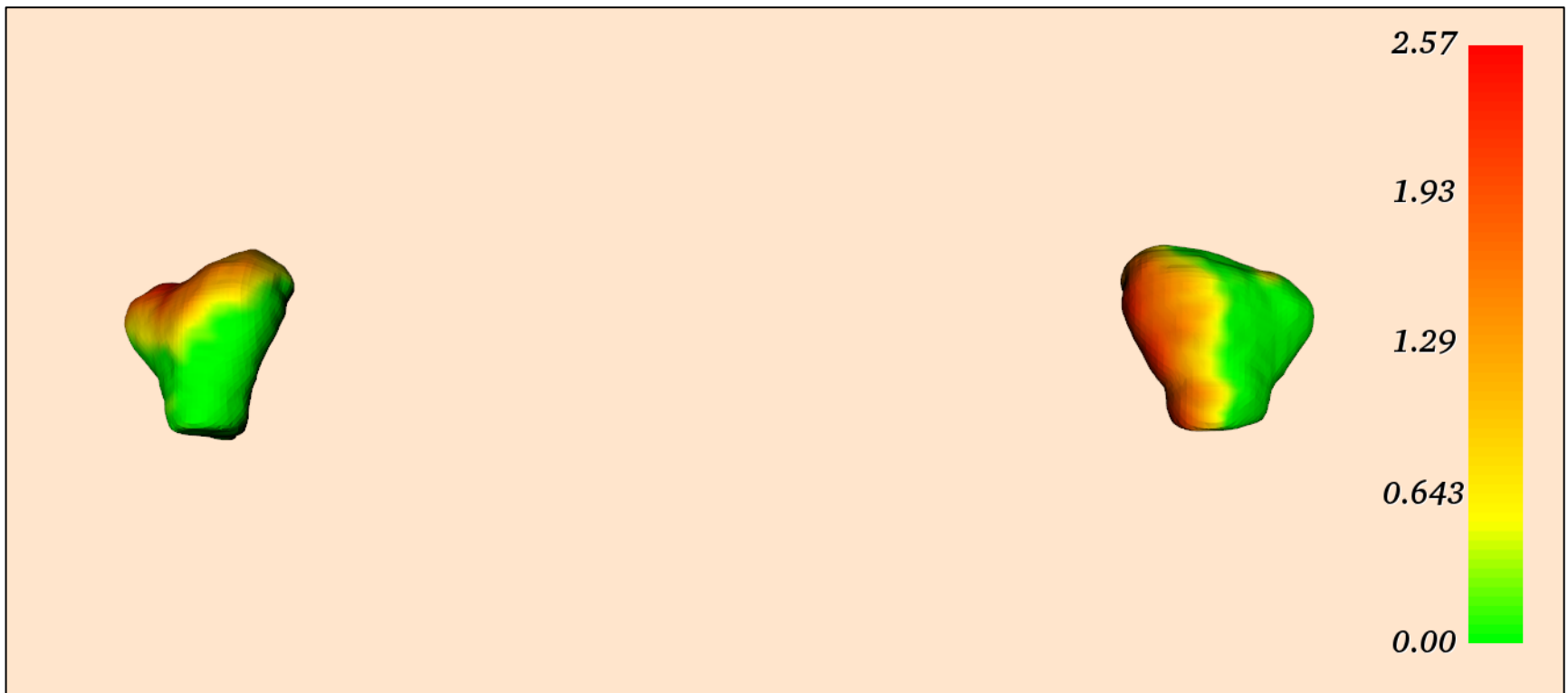
Examples of Color Map

- Signed distance with a different range



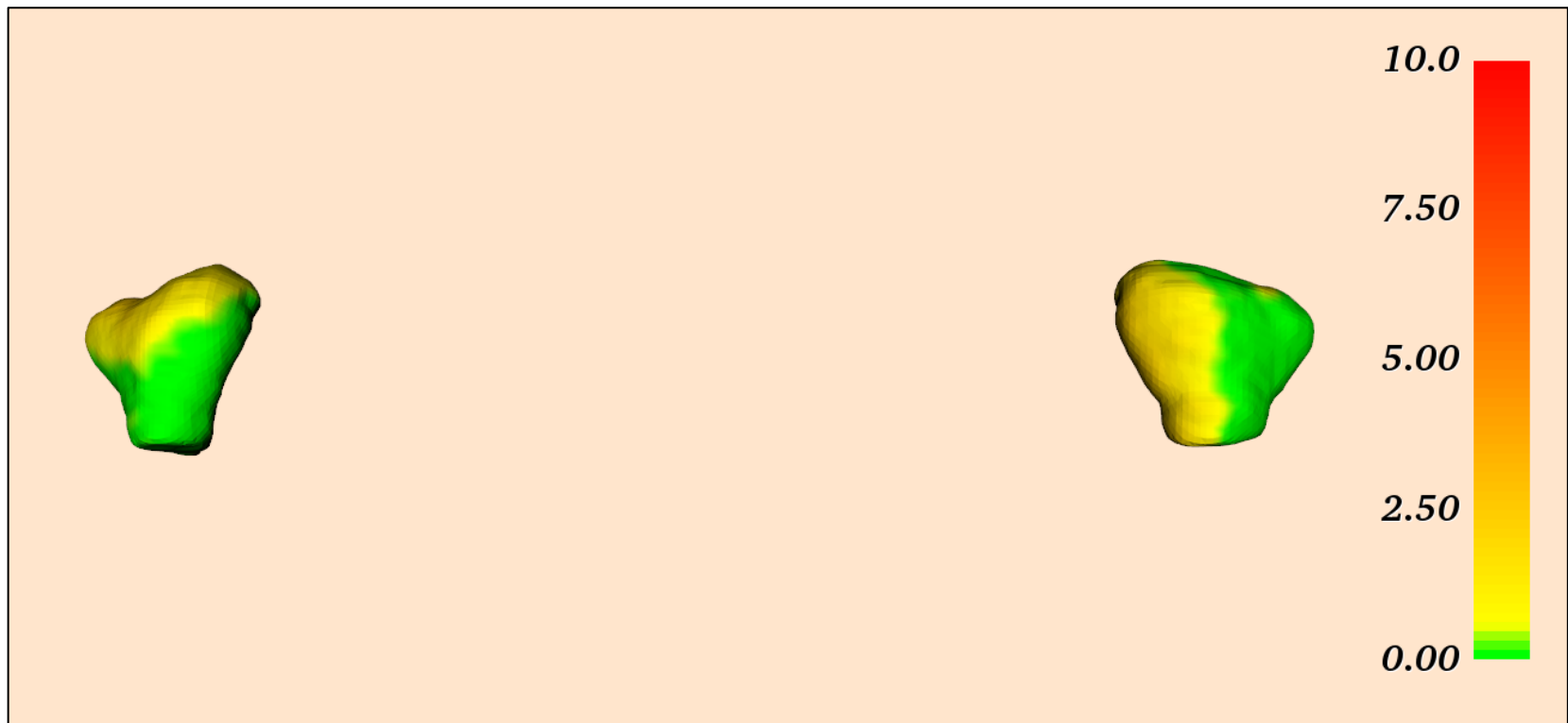
Examples of Color Map

- Absolute distance



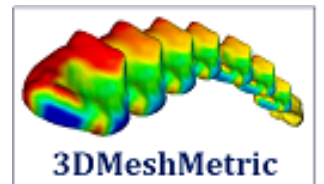
Examples of Color Map

- Absolute distance with a different range



3DMeshMetric

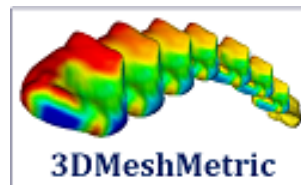
Training



Training dataset

The training dataset is available to download here :

<http://www.nitrc.org/projects/meshmetric3d>



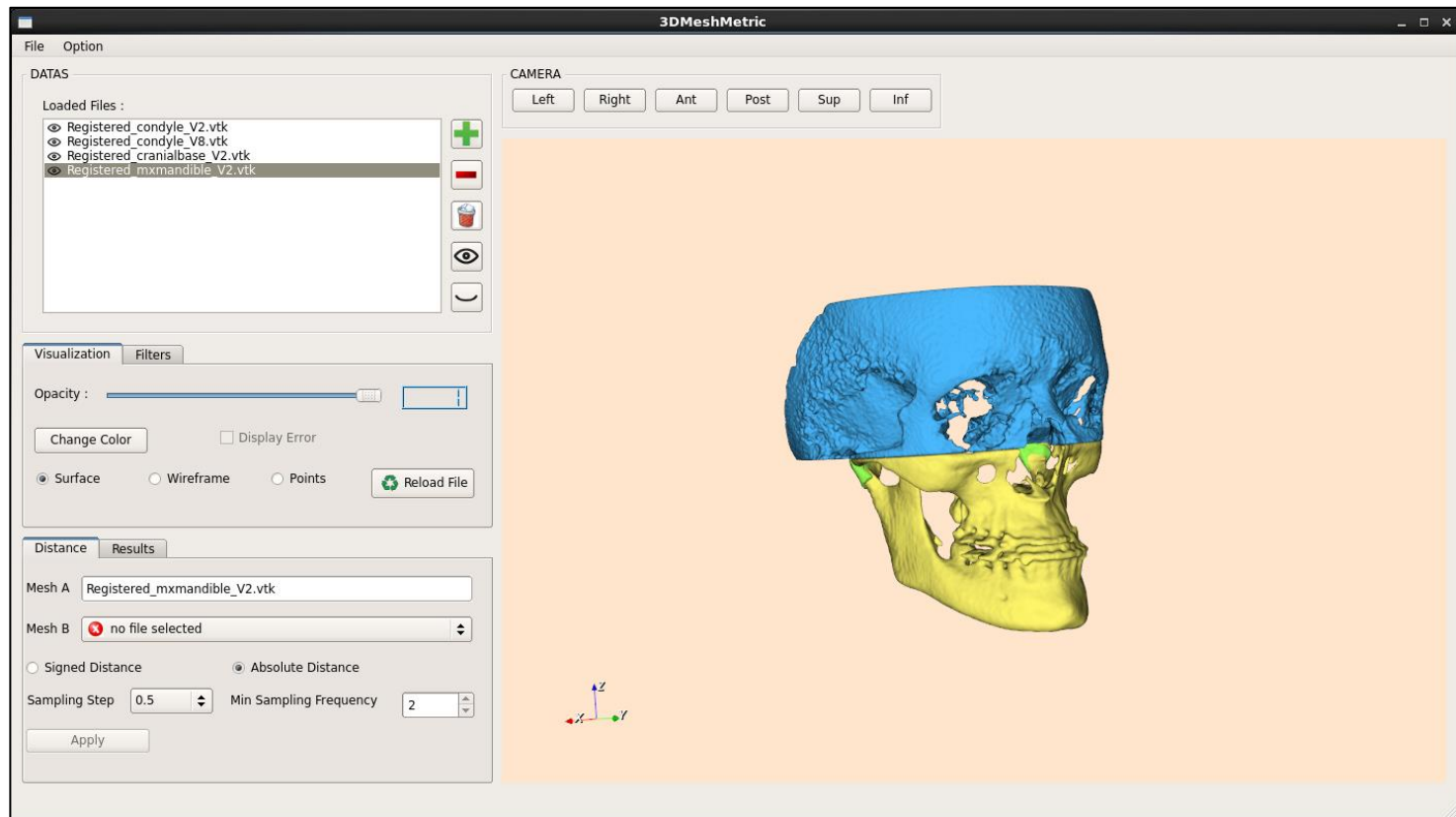
Load files

3 different ways to load **VTK** files (.vtk) :

- Data Box -> Loading icon
allow you to load one or more files
- File -> Add new file (Ctrl+A)
allow you to load one or more files
- File -> Add new folder (Ctrl+R)
allow you to load all the files contained on one folder

Load files

Load all the files contained on the training dataset, you will obtain something like that :



Camera

To change the view of your meshes you can use:

- The different views in the Camera box
- The mouse:
 - Left click : rotation of the meshes
 - Right click / Center roll : zoom in or zoom out
 - Center click : translation of the meshes

Visualization

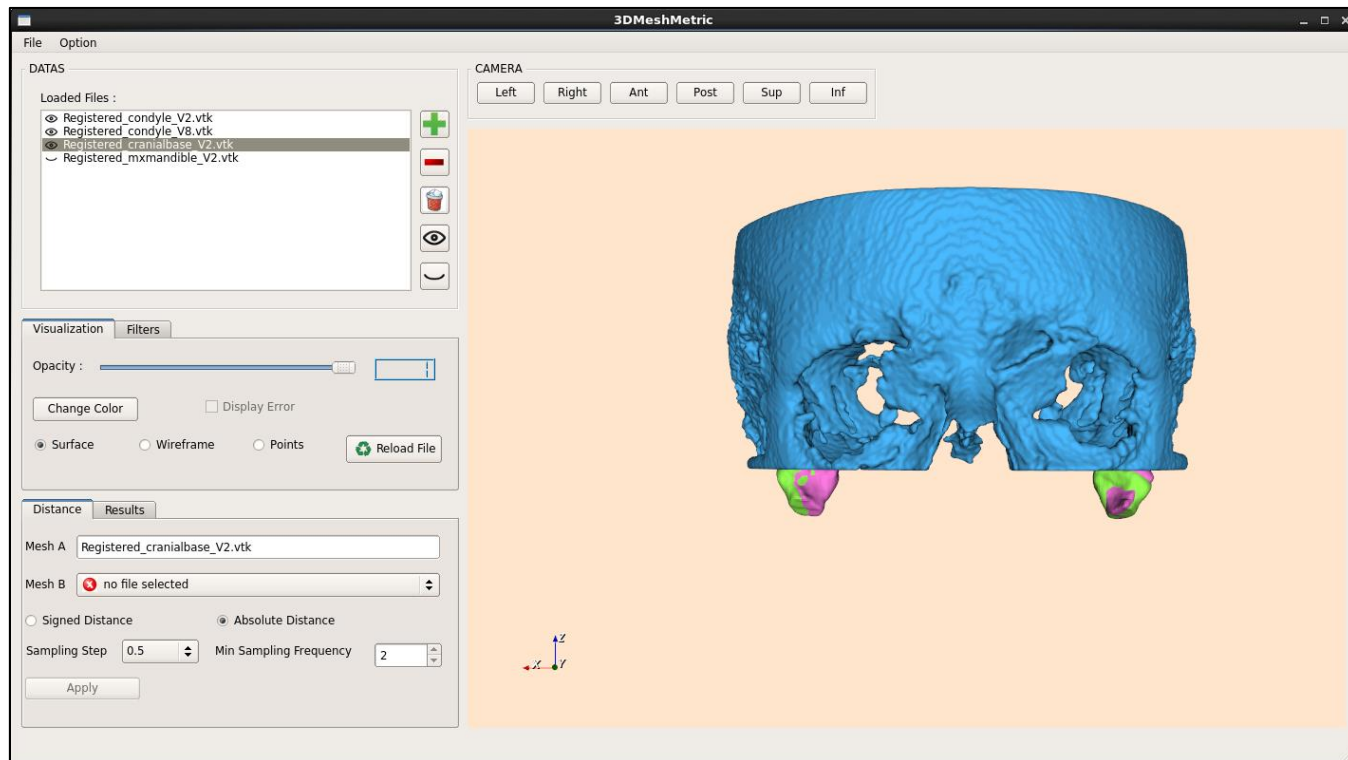
Now you can change visualization parameters for each file :

- Select your file : Data box -> click on your file
- The color : Visualization box -> push button color
- The opacity: Visualization box -> slider opacity

You can also decide to show or hide each file by clicking on the eye icon on the left of the file name.

Visualization

Hide the «Registered_mxmandible_V2.vtk» file to obtain this situation :



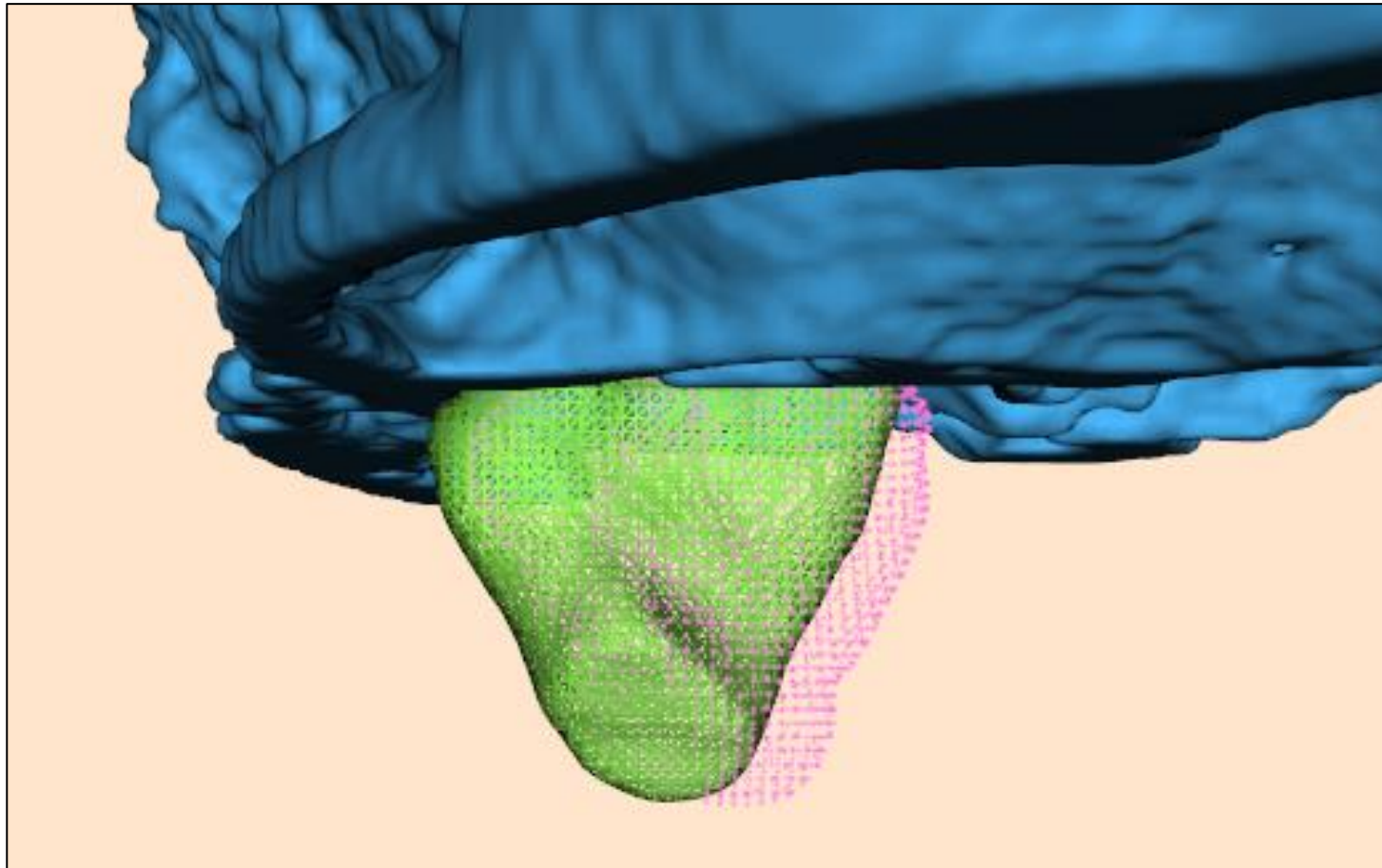
Visualization

You can also change the type of display of the selected file :

- Surface : Visualization box -> check box surface
- Triangles : Visualization box -> check box wireframe
- Points : Visualization box -> check box points

Visualization

Here an example of each type of display :



Filters

Two filters are available:

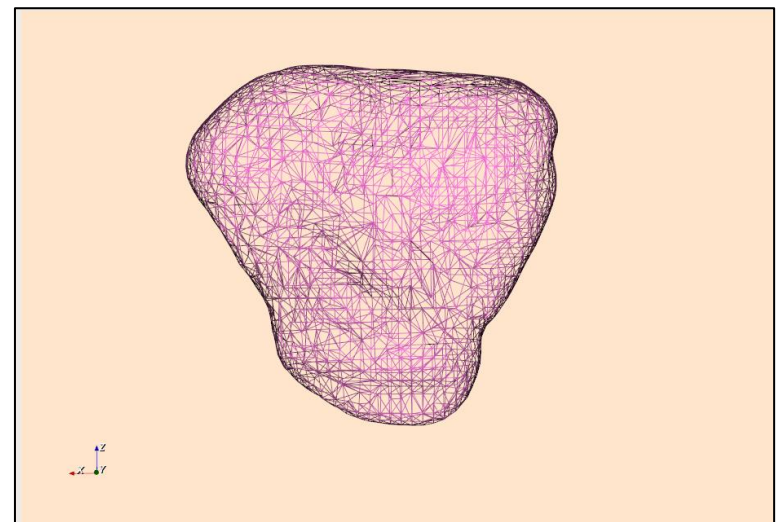
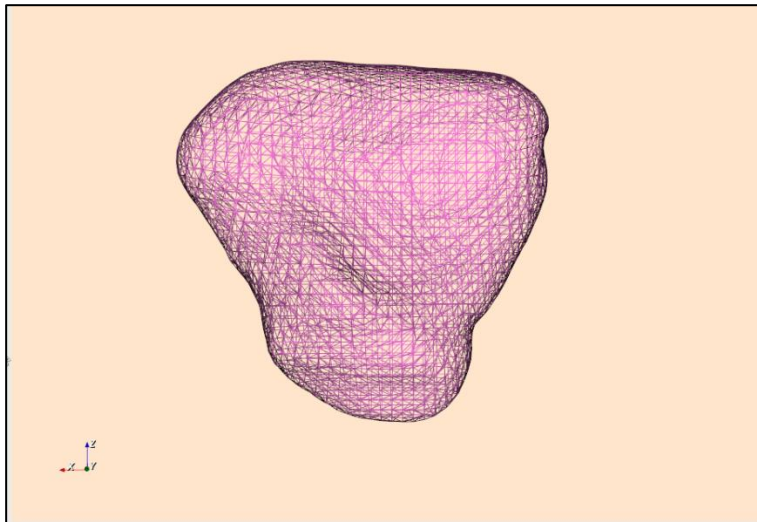
smoothing and **down-sampling**

- The down-sampling filter consists on decreasing the number of point on your file. If you are making a 10% down-sampling on a 1000 points file, the output file will have 900 points
- The smoothing filter consists on reducing the noise of the file. The more iteration you select, the more the aspect of the file will change

Filters

Select the «Registered_condyle_V2.vtk» file and display the wireframe.

Run the **down-sampling** filter with a **50% ratio**.



Filters

After any computation (down-sampling , smoothing or distance) you can reload your file as it was originally.

To do that, you have to select your file and then :

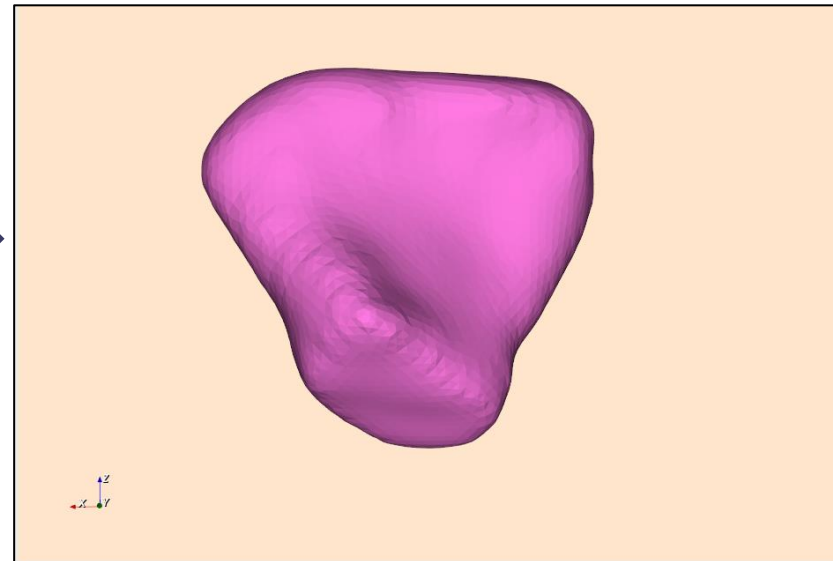
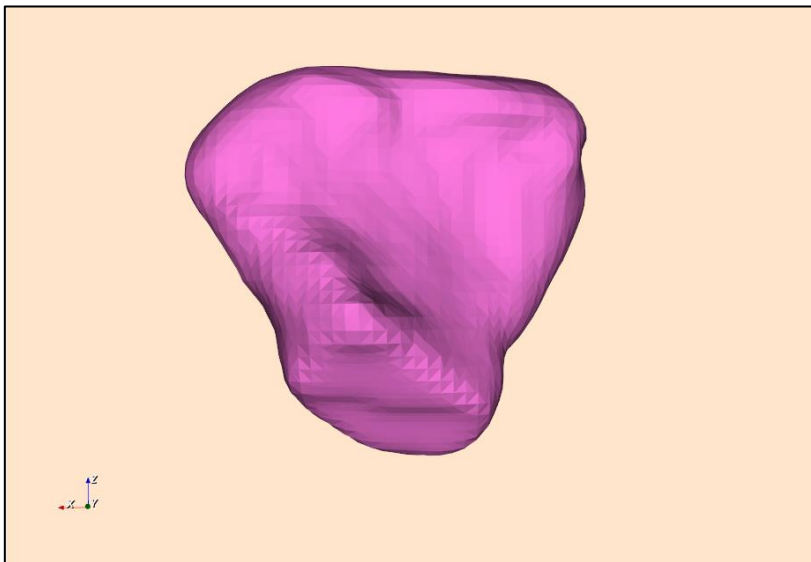
- Visualization box -> push button reload

Filters

Select the «Registered_condyle_V2.vtk» file and reload it.

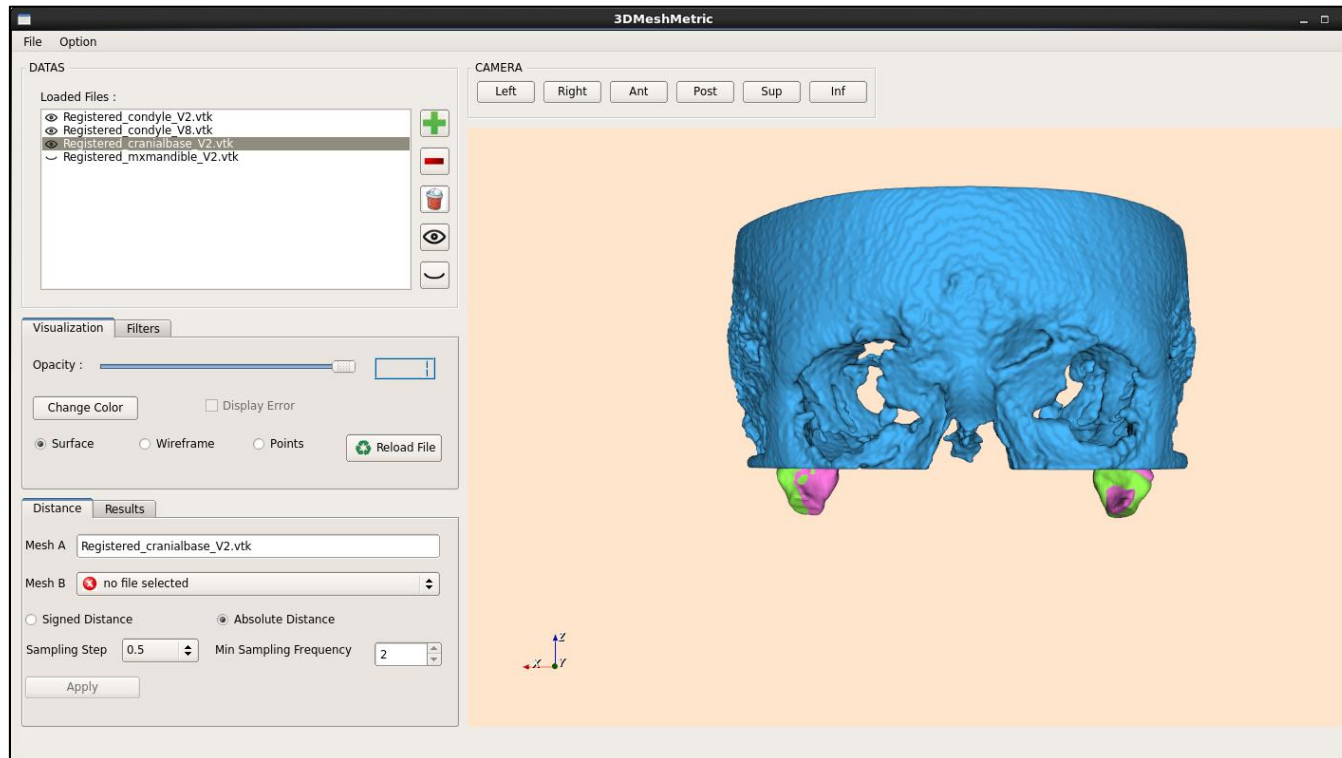
Display the surface.

Run the **smoothing** filter with **500 iterations**.



Distance

Now reload the file and go back to this situation :



Distance

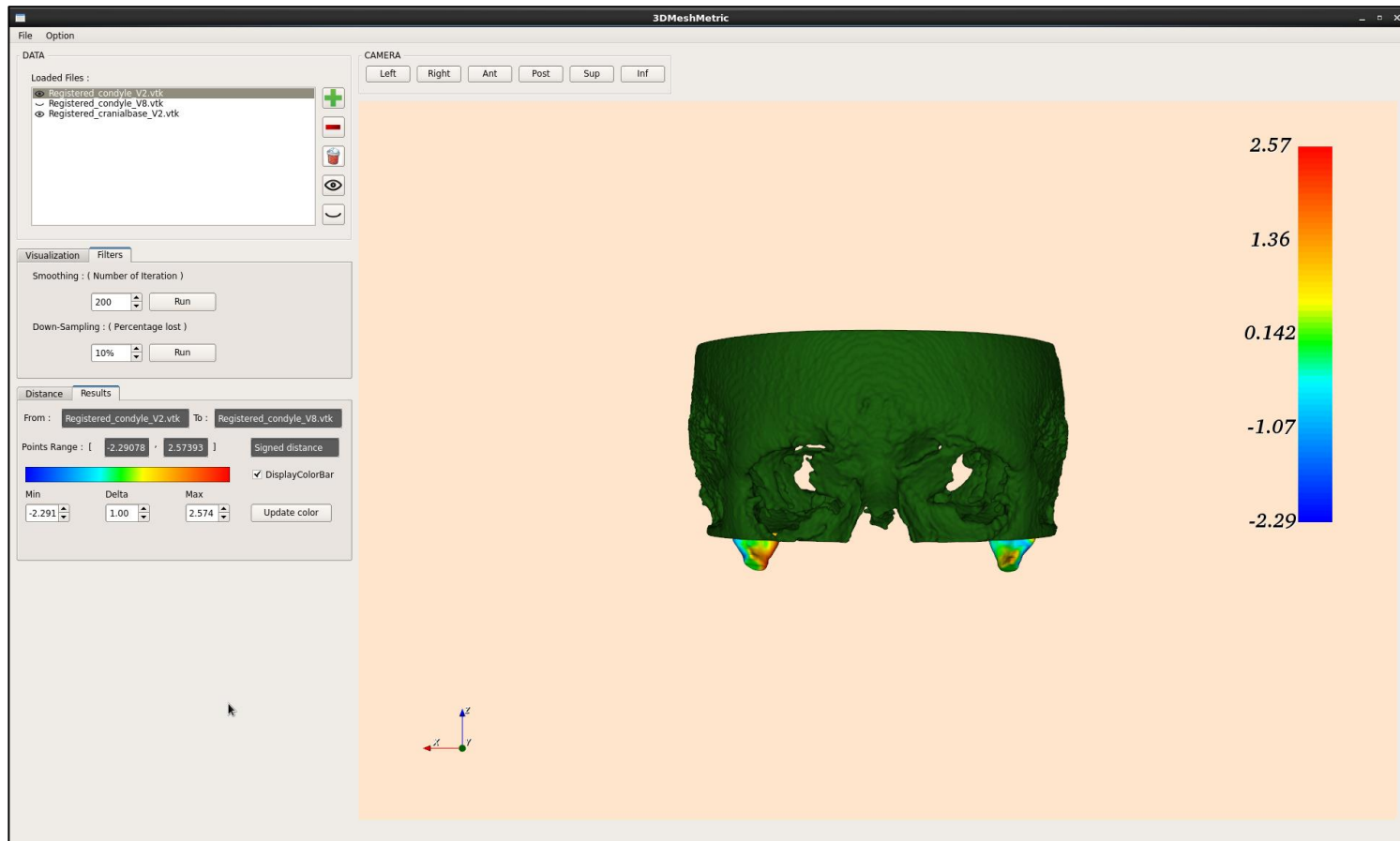
To compute the distance between the two condyles, first, select the «Registered_condyle_V2.vtk» file.

On the Distance box:

- Select the «Registered_condyle_V8.vtk» file on the drop-down list of Mesh B
- Select the signed distance
- Keep the advanced parameters as they are
- Compute the distance

Distance

You will obtain this kind of result :



Distance

Once you distance is computed, you may want to save it.

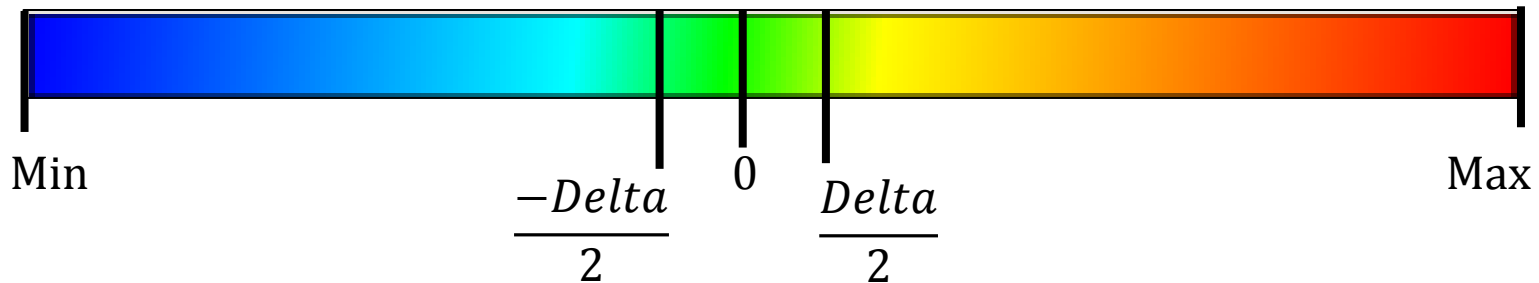
To save your file, select it and then :

- File -> Save file (Ctrl+S)
- Select the repository where you want to save it
- Change your file name
- Save it

Results

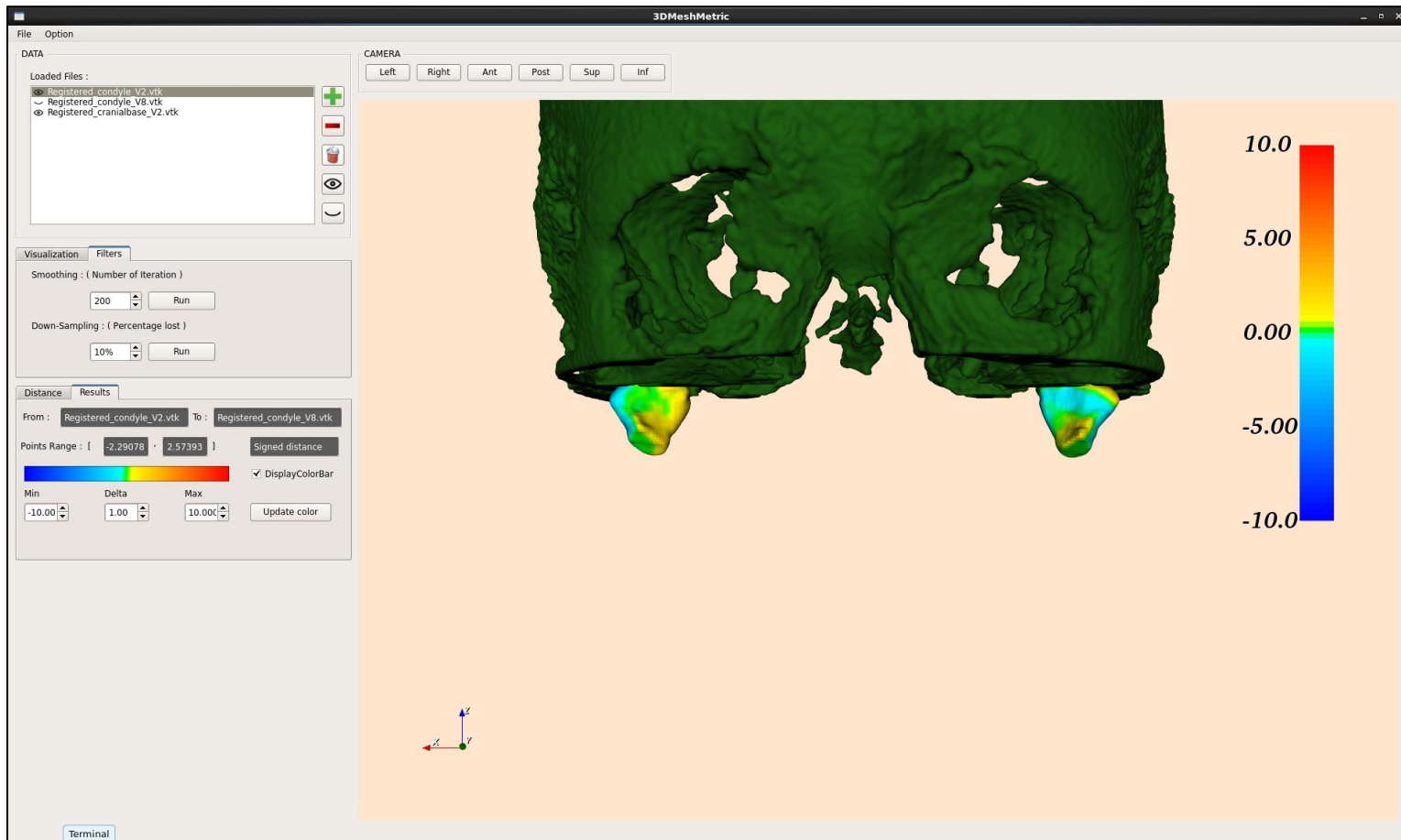
You can now change the actual range of the color bar.

- Value of blue color : Results box -> min
- Value of red color : Results box -> max
- Range of green color : Results box -> delta



Results

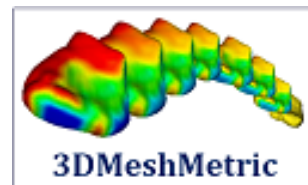
For a new min and max value of: -10 and +10



3DMeshMetric

For more information...

jpera@email.unc.edu



For more information...

3DMeshMetric NITRC page :

<http://www.nitrc.org/projects/meshmetric3d>

MeshValmet NITRC page :

<http://www.nitrc.org/projects/meshvalmet>